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“BURNING - GLASSES,” DUNDONALD’S DESTROYER ?

BY EDGAR STANTON MACLAY

IN the present war, the greatest in the world’s history, when man’s inventive genius has produced engines for the destruction of life and property, both on land and sea, which have appalled humanity for their wholesale awfulness, interest becomes more acute as to what manner of device was that “terrible invention” of Thomas Cochrane, the tenth earl of Dundonald, which the British Admiralty kept rigorously secret more than a hundred years as being “too horrible for humanity,” and which was so interestingly discussed in an editorial in the November number of this REVIEW. With the highest science and the best of mechanical devices at their command, present-day inventors have devised mechanisms which, by the merest touch of a button or the turning of a lever, have swept thousands of men into eternity. Yet, one hundred years ago, when science and the mechanical arts were in a comparatively primitive stage of development, Lord Dundonald created an engine of warfare which the highest authorities in the English navy declared to be so terrible that it “shocked humanity,” and would render wars between nations impossible. We know of the frightful destructiveness of present-day war weapons, yet, thus far, they have not brought any of the many warring nations to terms of peace. What could have been Lord Dundonald’s invention, perfected in the crude sciences and arts of a century ago, that by its terrific potentiality could accomplish more than the most powerful engines for destruction devised in the twentieth century?

While engaged in researches in the British Museum library, the writer found a small pamphlet, published in London toward the close of the eighteenth century, which described an invention of “burning-glasses,” whereby it was claimed that man was enabled to grasp the “veritable bolts of Jove himself” and hurl

them at his enemies. It fills out with convincing amplitude every detail of what was claimed for Dundonald's destroyer. It is not known if Dundonald obtained the ideas for his machine from these "burning-glasses," but it is known that the latter were experimented with by English scientists early in the nineteenth century, and results were obtained which fully substantiate Dundonald's claim that any foe, whether on sea or land, would be annihilated by their "terrific" power.

The essential idea of this singular device was the arrangement of several hundred mirrors in a great frame, at such angles as to catch and concentrate the rays of the sun on any desired spot. The power of these concentrated rays was so great as to explode any magazine, quickly set all woodwork in a flame, and to cause the instant death of any human being who came within the influence of their scorching breath. It was claimed that, so great was the heat generated in these concentrated sun rays, they could be swept along a line of advancing troops, causing each man to drop dead the moment the rays fell upon him. As is well known, wood entered largely into the construction of forts a century ago, when exploding shells were almost unknown. Gun-carriages were almost entirely of wood, while the "mantlets" that guarded each embrasure in the fortifications at Sebastopol were made of wood. With the terrific heat of these concentrated sun rays pouring into their embrasures, it was claimed that no men could stand by their guns, while all woodwork would be instantly set on fire.

It was in sea-fights, however, that these "burning-glasses" were declared to be most horrible in their execution. In these days of steel construction, when everything about the modern fighting craft, so far as possible, is made of metal (even to the masts, spars, standing rigging, and some of the running rigging), it is difficult for us to appreciate the unaffected terror the mariners of a century ago had for fire at sea. Their craft were built almost entirely of wood. Wood and hemp ropes, saturated with tar and oil, together with primitive hand-pumps, rendered a fire aboard ship one of the most dreaded foes of the old-time sailor. Add to these conditions the powder necessarily exposed along the decks in time of action and stored in magazines, and we can readily believe that the Admiralty was "horrified" over the power of these "burning-glasses" and made determined and continued efforts to conceal the invention from mankind.

So prominently did the "demon fire" enter into the life of old-time navies that we find the first considerable history of the

British navy (a solid work in six portly volumes by Capt. Isaac Schomberg, published late in the eighteenth century), entitled *A History of the English Navy and an Account of "Conflagrations" in His Majesty's Warships and Dock-yards*. If these "burning-glasses" generated only half the heat credited to them, it is easy to understand how they could easily set instantly on fire any of the old-time wooden ships opposed to them. Indeed, the officers and crew of the doomed craft would have had difficulty in leaving before her magazine blew up.

While difficulties were encountered in adapting "burning-glasses" to naval warfare, not one of them was insurmountable. The rolling and pitching motions of water craft were easily accommodated in a manner similar to that employed with "floating" compasses, whereby a degree of stability was acquired sufficient to maintain a direct line with the sun and transmit its concentrated rays to the desired objective. As to the delicate mechanism or fragile nature of these glasses being shattered by hostile shot, it must be remembered that a century ago ordnance was of a comparatively low power; so much so, in fact, that it was the rule rather than the exception for opposing war craft to hammer each other for hours and sometimes days without any being sunk—and the thickness of planks in militant craft then was only about four inches.

It would have been an easy matter to fortify the small space occupied by a frame of "burning-glasses" with timbers massive enough to render them impervious to shot—the narrow slit through which the concentrated rays were to be projected against an enemy affording an infinitesimally small target for the cumbersome cannon of those days. With this "horrible" engine of death and destruction thus protected, it was quite possible for a war craft to approach close enough to an adversary to set the latter instantly afire.

On land the operation was simpler. There, also, old-time ordnance was of low velocity and, consequently, of less smashing power. Not having the rolling and pitching motions of water craft to overcome, the operators confined their attention to moving the "frame" on wheels, and, under the protection of massive timbers, could bring it within the desired distance from the enemy's fortifications in spite of the heaviest cannon-fire then known.

Just what was the "distance" necessary for the most effective operation of these "burning-glasses" is left to conjecture, but when we read how Archimedes, by means of polished metal

mirrors, burned completely to ashes the Roman ships besieging Syracuse, and that Proclus by the same means destroyed the galleys of Vitalian when attacking Byzantium, we can believe that the opponents were not very far apart. That these reports of ancient "burning-glasses" are not entirely mythical has been demonstrated by modern scientific experiments. With only five plane mirrors in a frame, Kircher concentrated a degree of heat at a point one hundred feet away sufficient to ignite wood; and he concluded that by increasing the number of mirrors he could develop almost any degree of heat. He visited Syracuse, and, from actual measurements, declared that the Roman galleys could not have been more than one hundred feet from the "burning-glasses" of Archimedes. By using one hundred and sixty-eight mirrors Buffon constructed a frame by which he set fire to the hardest wood at a distance of one hundred and sixty-five feet. Increasing the number of mirrors to four hundred, he found that he could melt lead and tin at one hundred and fifty feet.

That these "burning-glasses" were known in England at the time Dundonald made his invention is shown in the fact that an English artisan named Penn constructed a powerful lens by which steel and flint were melted like wax, while a ten-grain diamond, after being subjected to this heat thirty minutes, was reduced to six grains.

With these well-authenticated modern experiments before us we can readily understand how it became merely a matter of mechanical ingenuity to arrange these "burning-glasses" for war purposes. When we remember that England's main reliance for national defense was on her navy, with its "walls of oak" saturated with tar and surmounted with highly inflammable oiled ropes, we better appreciate the Admiralty's "horror" for this method of sea-fighting.

At the time Syracuse was besieged by the Romans, gunpowder or high explosives of any kind were unknown. With the advent of "gunpowder cannon" in war craft the storage of explosives in war-vessels added vastly to the terror of these "burning-glasses." In the days of wooden war craft naval engagements were fought, as a rule, at the closest quarters; a favorite strategy being to "lay the enemy alongside," board in the smoke of broadsides, and decide the issue in a hand-to-hand struggle on the adversary's deck. With "burning-glasses" having power to melt lead or tin at a distance of one hundred and fifty feet we can readily understand how a frigate thus equipped could

instantly set the oil-soaked rigging and tar-saturated planks of an opposing vessel aflame; while the terrific heat pouring through the open gun-ports would cause the instant death of men facing it, besides igniting the powder necessarily stored along the decks and leading to the magazines.

Dundonald's destroyer was thoroughly tested by five of the highest experts then in the British navy—namely, the Duke of York as commander-in-chief of the English army, Admirals Lord Keith and Exmouth, and the two Congreve brothers for whom the celebrated war-rocket was named. The fact that the inventors of these rockets were placed on this board of experts is suggestive that Dundonald's invention was in the nature of "burning-glasses," as they were operated somewhat on the principle of rockets.

Dundonald declared that his destroyer afforded "the infallible means of securing at one blow our maritime superiority and of thereafter maintaining it in perpetuity," that "no power on earth could stand against it," that it could be used by the weakest nation against the strongest, and that its construction was so simple that the most ignorant minds could readily master its mechanism. These "burning-glasses," if operated in naval and land warfare as it existed a century ago, seem to fill all these conditions. But, with the advent of high-power and long-range ordnance, the "terror" of this peculiar engine of destruction disappears.

In a different form, however, the ancient "burning-glasses" promise to become a potent factor in land and sea contests. Instead of utilizing sun rays, Italian inventors have made experiments with the violet or F-ray by means of which they claim they can explode the magazine of any fort or ship at a distance of nine miles. Their successes with the wireless telegraph entitle their claims to serious consideration. The principle is easy enough, but the difficulty has been to establish the "projector" of the F-ray at a point in the enemy's rear where the fort or hostile war craft will be on a direct line between the "projector" and its "receiver." The difficulty of reaching an enemy's rear, especially on land, is obvious, and it is this difficulty which gives hope of further postponement of the practical workings of this "terrible destroyer" of the twentieth century. Conditions surrounding the mysterious explosion which destroyed the British battle-ship *Bulwark* have led some experts to believe that she was a victim of this new method of attack.

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